

April, 30, '40

R-LS  
BRANCH STATIONS  
Northern Plains

MEMORANDUM FOR THE DIRECTOR:

Since 1931 we have carried out experiments on the 640-acre area at Denbigh, North Dakota, to determine the feasibility of forest planting.

The experimental area lies in an old glacial lake-bed in McHenry, Pierce, and Bottineau Counties, and there are about 200,000 acres of sandy submarginal land, of which about 90 percent is flat-lying sandplains and the rest scattered dunes ranging in size from 20 to 2,000 acres and which lie 20 to 50 feet above the level of the sandplain. A glance at the soil survey map of McHenry County will show the distribution of the dunes. The dunes are covered in places with a thin growth of bur oak, boxelder, hackberry, white elm, green ash, choke-cherry, and quaking aspen. The level portions of the area are mostly grassland but in some places support natural aspen, cottonwood, and low, shrubby willows. Practically all of the more level land has a permanent water table within 6 to 12 feet of the surface of the soil, and this is a remarkable aid to cottonwood and other water-loving plants, once they have pushed their root systems deep enough to tap the capillary fringe of moist soil which lies just above the water table.

The nearest approach to the North Dakota sandhills is the Nebraska National Forest, and, in fact, it was the Nebraska Forest which furnished the inspiration to local people to request establishment of a forest experiment station in the North Dakota sandhills area.

Because of the apparent similarity of the two areas, Rudolf and Scholz, who supervised the first planting in the Denbigh area in 1931 to 1933, used the same technique adopted on the Nebraska Forest for ground preparation and planting methods, that is, plowing a narrow 12-inch-wide furrow and planting trees, with no plan for future cultivation.

These techniques were fairly satisfactory for the dune-sand areas, but failed completely on the level areas where sod was dense and competition for moisture very severe, and the plantations showed mediocre survival and practically no growth.

In 1934 the writer introduced a system of ground preparation on such areas which consisted of plowing 5-foot-wide strips which were alternated with 2-foot-wide strips of sod to prevent excessive soil blowing. The first planting was done in 1935 on plowed areas and prospects for success appeared brighter. Survival was better and growth was very much better in the plowed and cultivated areas. It now appears that 4 to 5 cultivations are necessary per year, for three to five consecutive years.

To date we have found 2-0 green ash, 2-2 ponderosa pine, and 2-1 or 2-2 red cedar the best species and age classes. With cottonwoods, nursery-grown seedlings may be necessary, or perhaps 1-year-old wildings which have been lined out in the nursery for an additional year. Ordinary wildings taken from river sandbars or margins of lakes have given poor initial survival.

Best growth and survival is being obtained on the smooth-lying land which can be cultivated. On the dune areas where planting is done in scalps, and no horse or machine cultivation is possible, we have obtained only one moderately successful plantation of ponderosa pine, and that only by use of dry brush laid over the scalp to shade the trees and to reduce heat injury and transpiration losses.

The technique of ground preparation and cultivation on the flat land is, of course, a radical departure from the technique used on any national-forest planting areas. It closely resembles technique used by the Prairie States Forestry Project in its shelterbelt plantings, and may require some modification to fit various soil conditions and species.

Such cultivation and intensive plantation care costs considerable money, even though mechanized as much as possible, and it raises the question as to how much area should be planted in case a purchase unit is set up in this part of North Dakota.

My own feeling is that only about 10 to 20 percent of the area should ever be considered for forest planting, and the remainder devoted to grazing and cutting of wild hay. If the whole area were used for reforestation it would seriously upset the economy of the county, which is based to a considerable extent on ranching, and there would be much opposition to such a move.

The planting which is done could best serve its highest use by concentrating such planting in narrow strips about one-half mile in width on each side of the main highways in the area (U.S. #2 and State Highway #14). In time, some excellent campgrounds and recreational facilities could be established in the planted areas.

By a proper combination of green ash, cottonwood, ponderosa pine, western red cedar, and a few shrub species, a good diversity of species can be planted with a maximum aesthetic and recreational value. As the material became merchantable it could be sold for fence posts, fuel, corral poles, and even for rough lumber. Cutting would necessarily be sharply restricted in and near campgrounds.

Our efforts at Denbigh substation have naturally been directed largely at the tree-growing aspect of the job, but some attention has been given to the broader aspect of land use, such as grazing, recreation, and wild game. Because of the importance of grazing in the economy of

the area, it would be desirable to employ a full-time man on grazing research.

It is probable that this section of the State receives fully 40 to 50 percent of its income from the livestock industry, and consequently the range land looms up importantly from an economic and land-use viewpoint.

The obvious retrogression of the range in places has become so severe, due to overgrazing, that areas once supporting a fine cover of palatable and nutritious grasses are now converted into moving sand dunes, or blowouts which can scour no deeper because the sand has been cut away to a depth of 6 feet and has thus exposed the substrate to within a foot or two of the water table, where the sand is perpetually moist. Some of the worst areas present spectacular stages of wind erosion, but probably more serious is the slow but insidious depletion of the range resources, and reduction of carrying capacity of a considerable part of the range. A common observation has been the virtual disappearance of Andropogon furcatus, which was once common over the entire sandplains area some 20 to 25 years ago. Is this due to deficient rainfall, lowering of water table, overstocking, or a combination of all three factors? It is obvious that some intensive research is needed to lay the groundwork for safeguarding the range resources of this section of the Great Plains.

The work would include a survey of the entire area as to present land use, carrying capacity of the various plant associations, *study of poisonous plants & their control*, degree of over- or under-utilization of the range, necessity for better practice such as proper salting methods, deferred and rotation grazing, fencing out and stabilization by natural or artificial revegetation of wind-eroded areas caused by overgrazing, unwise concentration of stock, poor windmill location, wrong class of stock, or plowing of land which is inherently not suited for cultivated crops. In addition to this, it seems highly desirable to study the effect of prairie fires on vegetation of the range, the necessity of fire protection by plowed or burned fire lines, and effectiveness of highly mobile fire-fighting equipment such as large trucks equipped with big water tanks which would be used to fight prairie fires by the "direct" method.

Naturally, with the continually shrinking appropriation made for the Denbigh Station, which has dropped from some \$15,000 in 1930 to around \$3,800 in 1939, much of which was ERA and other relief funds, with their restrictive uses, we have not been able to do as much research on the grazing-management phase of the work as is desirable.

We have to date done the following things which will serve as a basis for more intensive work;

1. The carrying capacity of typical range land from quadrat studies and interviews with ranchers was determined as ranging from 7 to 40 acres per cow for the 5-month grazing season. On the best of the range it requires 7 to 15 acres. On the light-dune-sand areas, up to 30 or 40 acres are required per cow. The better range land in this area, on the basis of carrying capacity, is, of course, very much better than much national-forest range.

2. A series of 66 meter-square quadrats was established in 1936 in various plant associations, soil types, and intensities of grazing. These are listed annually, and certain of them have been clipped and the forage dried and weighed.

The quadrats reveal that the most important species are Stipa comata, Bouteloua gracilis, Carex filifolia, Andropogon scoparius and furcatus, Calamovilfa longifolia, Redfieldia flexuosa, Agropyron tenerum, and Spartina pectinata. The quadrats show that the natural rate of revegetation of seriously overgrazed and wind-eroded areas is very slow, and suggests necessity for artificial seeding and tree planting.

3. A close correlation was established between soil type and vegetation, and since the county was mapped in detail in 1925 (on a scale of 1 inch to the mile) by the Bureau of Chemistry and Soils, this soil map can serve

as a basis for blocking the area into land-use units and will be of aid in a range reconnaissance survey, location of water developments, and for locating gravel and clay deposits for use in road building.

4. Studies of water-table depth showed a striking correlation with soil types, and this is so good that in 8 out of 10 cases one can estimate depth to water table within 5 feet, in the sandhill area and adjoining land. This knowledge would be of great value in development of watering places for stock. In this area practically all water developments consist of sand points from which water is pumped by windmills.

5. A herbarium of approximately 70 genera and 110 species has been collected. This was useful to the Forest Service men who worked on the AAA range program under Mr. Lee Kirby in 1936 and 1937.

6. Some 40 different native and introduced species of range plants, some furnished by the Soil Conservation Service, were seeded and tested over a period of several years in small rod-row or rod-square plots to determine their adaptability and value for revegetation of run-down range land. It was found that Stipa comata and Agropyron cristatum were the best species.

7. In an attempt at reclamation of a badly wind-eroded sandy field which was making one of the county roads impassable because of soil drifting, we succeeded in



stabilizing the field by planting cottonwood wildings and listing the area during the first two years. At three years of age the plantings have almost completely stopped the movement of soil, the road ditch has been plowed out, and the road is passable. The trees were 4 to 10 feet tall at age 3.

Because of the powerful abrasive action of the shifting sand, attempts at revegetation with seed and rhizomes of native and cultivated grasses and forage plants failed. Only the rapid-growing cottonwood was able to survive the sand blast. Various other tree and shrub species failed to survive.

8. An experimental water hole was dug to determine feasibility for use by wild game and to some extent by livestock. It seems questionable at this time whether water holes would be as satisfactory as a sand point, windmill, and tank. They do merit further trial.

9. The experimental section of 640 acres has been protected by a system of fire lines to check prairie fires, and some ranchers have since constructed their own fire-breaks. They serve the purpose of protecting the range and preventing wild hay land or haystacks from being burned.

10. Records have been kept since 1932 of the water-table fluctuation in a number of dug wells on the station section. This record is of value because the amount of

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affects not only tree planting but also production of forage and wild hay in some of the shallow-water-table areas.

11. A system was devised of studying root habits of plants by a method of hydraulic excavation with a power pump drawing water from a sand point. This was published in Ecology in July 1938.

It is recommended that reference be made to the 1935-1938 report for our Northern Plains Branch station because we have a good set of photographs which illustrate various phases of the work at Denbigh Station. It also contains summaries of our activities on planting, ecological and grazing investigations, game studies and census data, water-table data, and shelterbelt-influence studies. A copy of this, complete with illustrations, was sent to Research in Washington in 1939. X

J. H. Stoeckeler

Assoc. Silv.